

Quantification of Uncertainties in Integrated Spacecraft System Models, Phase I

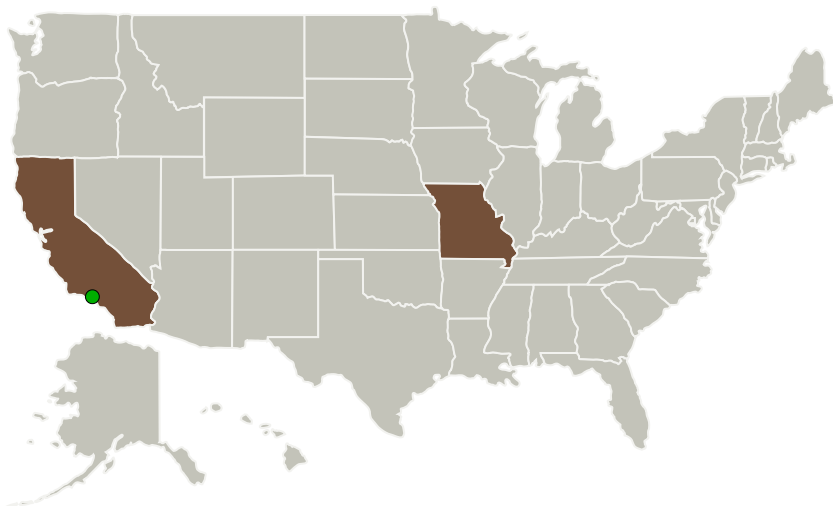
Completed Technology Project (2010 - 2011)



Project Introduction

The proposed effort is to investigate a novel uncertainty quantification (UQ) approach based on non-intrusive polynomial chaos (NIPC) for computationally efficient and accurate quantification of uncertainties in spacecraft system models within a multidisciplinary analysis and optimization (MAO) framework. The UQ approach will include the modeling of both inherent (probabilistic) and epistemic uncertainties and the propagation of these with NIPC. Comparisons between crude Monte-Carlo sampling will be made during validation of the approach. Software will be developed to implement the UQ approach in a generic way. With scalability in mind, this software will be utilized within a space system MAO framework containing many uncertain parameters. Also in Phase I, a simple graphical user interface will be created to implement the UQ approach. Both the software and UQ approach developed will be tested on a model spacecraft simulation problem with uncertainties. This proposed work will compliment M4 Engineering's expertise in developing modeling and simulation technologies that solve relevant demonstration applications. The researchers from Missouri S&T (RI) will guide the implementation of UQ methodology and contribute to the proposed effort with their experience and expertise in UQ in aerospace simulations.

Primary U.S. Work Locations and Key Partners



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| Organizations Performing Work | Role | Type | Location |
|----------------------------------|-------------------------|--|------------------------|
| M4 Engineering, Inc. | Lead Organization | Industry Women-Owned Small Business (WOSB) | Long Beach, California |
| ● Jet Propulsion Laboratory(JPL) | Supporting Organization | NASA Center | Pasadena, California |
| University of Missouri-Columbia | Supporting Organization | Academia | Columbia, Missouri |

Primary U.S. Work Locations

| | |
|------------|----------|
| California | Missouri |
|------------|----------|

Project Transitions

▶ **January 2010:** Project Start

✓ **January 2011:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140141>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

M4 Engineering, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

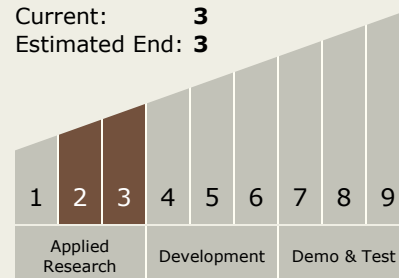
Carlos Torrez

Principal Investigator:

Tyler Winter

Technology Maturity (TRL)

Start: 2
Current: 3
Estimated End: 3



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Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
 - └ TX09.4 Vehicle Systems
 - └ TX09.4.5 Modeling and Simulation for EDL

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System